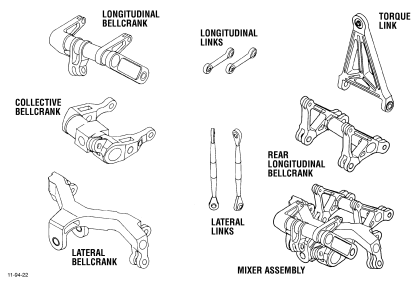


P. Upper flight controls

1. The upper flight controls are located in the main rotor mast area. They provide the means for translating mechanical and electrical inputs to the lateral, longitudinal, and collective servoactuators to the appropriate main rotor blade action.
2. The upper flight controls combine control inputs received from the collective, longitudinal, and lateral hydraulic servoactuators for vertical, longitudinal, and lateral flight control of the helicopter.
3. Receives non-rotating control action and transmits rotating control action to the main rotor head.
 - a. Mounted between the main rotor head assembly and main rotor support structure base assembly surrounding the static mast.
 - b. The upper flight controls are made up of various bellcranks, links, a swashplate assembly, and two scissors assemblies.
4. Description
 - a. The upper flight controls are made up of the scissors assembly, swashplate assembly, mixer assembly, pitch link assembly, torque link, and lateral link.
 - (1) The controls consist of a longitudinal, lateral, collective, and rear longitudinal bellcranks, two lateral links, two longitudinal links, with a torque link to prevent the stationary swashplate from turning.
 - (2) These bellcranks and links are made of 7149 aluminum castings. They are relatively large because this area does not have redundant controls.
 - (3) The large hollow bolts that are used to assemble the mixing unit each have self-retaining pins to prevent their loss if a nut were to back off. A center pin on each bolt must be pushed in to release the lock.
5. Major components
 - a. Mixer assembly
 - b. Swashplate assembly
 - c. Pitch link assemblies (4)
 - d. Scissor assemblies (2)
 - e. Torque link



MIXER ASSEMBLY COMPONENTS



NOTES

6. Major component purpose, location and description

a. Mixer assembly

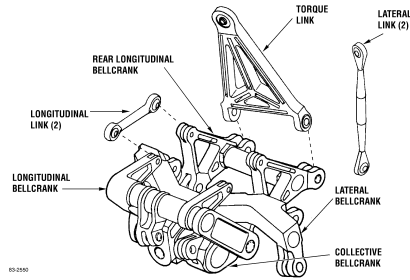
- (1) The purpose of the mixer assembly is to intermix control inputs from the longitudinal, lateral, and collective servoactuators, and transmits control inputs to the main rotor swashplate. It receives and combines control inputs from the collective and cyclic control sticks for vertical, longitudinal, and lateral flight of the helicopter.
- (2) The mixer is mounted above the main rotor support structure base assembly.

b. The mixer assembly major components form a network of bellcranks interconnected with various links.

- (1) Collective bellcrank
- (2) Longitudinal bellcrank
- (3) Rear longitudinal bellcrank
- (4) Lateral bellcrank
- (5) Longitudinal links (2)
- (6) Lateral links (2)
- (7) Torque link



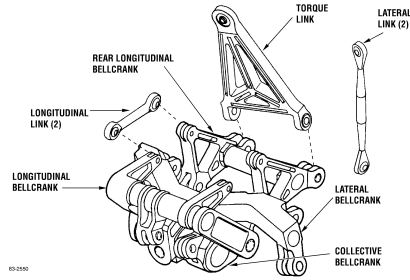
MIXER ASSEMBLY (1)



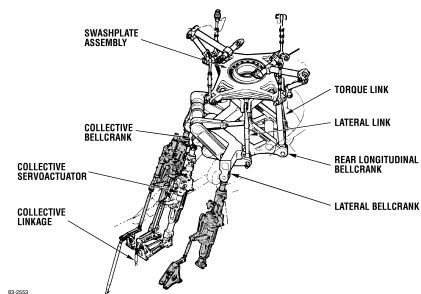
NOTES

c. Mixer description

- (1) Collective bellcrank
 - (a) Is horn-shaped, with the horns facing aft, and is attached to the collective servoactuator, support bearings, and lateral and rear longitudinal bellcrank.
 - (b) Receives input motion from the collective servoactuator and transmits vertical linear motion to the non-rotating swashplate.
- (2) Longitudinal bellcrank
 - (a) Is horn-shaped, with both horns facing aft, and is attached to the longitudinal servoactuator, support bearings, and two longitudinal links.
 - (b) Receives input motion from the longitudinal servoactuator and transmits longitudinal linear motion to the rear longitudinal bellcrank through the two longitudinal links.
- (3) Rear longitudinal bellcrank
 - (a) Is triangular-shaped, and is attached to the collective bellcrank, two longitudinal links, and torque link.
 - (b) Receives input motion from the two longitudinal links, and transmits and changes longitudinal linear motion into vertical linear motion to the torque link.
- (4) Lateral bellcrank
 - (a) Has a long "T" shape, and is attached to the lateral servoactuator, collective bellcrank, and two lateral links.
 - (b) Receives input motion from the lateral servoactuator and transmits linear motion to the non-rotating swashplate through the lateral links.
- (5) Two longitudinal links
 - (a) Are connected to the longitudinal bellcrank and the rear longitudinal bellcrank.
- (6) Two lateral links
 - (a) Are long push-pull tubes attached to the lateral bellcrank and the stationary swashplate.
 - (b) Transmits linear motion from the lateral bellcrank to the non-rotating swashplate.

**MIXER ASSEMBLY (1)****NOTES**

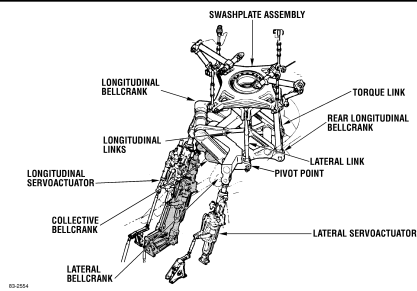
- (7) Torque link
 - (a) Is made of aluminum alloy and is attached to the rear longitudinal bellcrank (two places) and to the stationary swashplate (one place).
 - (b) Transmits linear motion from the rear longitudinal bellcrank to the non-rotating swashplate and prevents rotation of the stationary swashplate.

**COLLECTIVE MIXING OPERATION****NOTES**

d. Mixer operation

(1) Collective mixing operation

- (a) An increase in collective mechanical linkage input to the collective servoactuator will initiate the following:
- 1) The collective bellcrank will pivot forward (down), moving the rear horns up.
 - 2) Simultaneously, the lateral bellcrank will move forward (down), moving the two lateral links up and the rear longitudinal bellcrank will move up, pivoting on the longitudinal links and moving the torque link up.
 - 3) The combined lateral links and torque link upward movement will raise the swashplate assembly, increasing the blade pitch angle an equal amount on all four blades.

**LATERAL AND LONGITUDINAL
MIXING OPERATION****NOTES**

(2) Lateral mixing operation

- (a) A downward movement of the lateral bellcrank by the servoactuator will initiate the following:
 - 1) The lateral bellcrank will pivot around its axis.
 - 2) The left lateral link will move down.
 - 3) The right lateral link will move up.
 - 4) The combined left and right lateral link movement will cause the swashplate to tilt to the left.

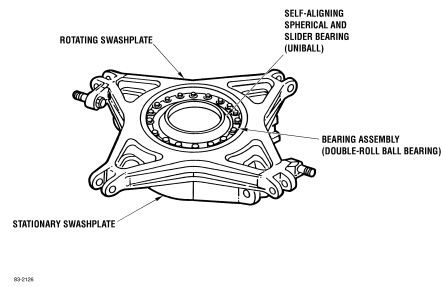
(3) Longitudinal mixer operation

- (a) Forward motion applied to the cyclic control stick will retract the servoactuator rod and initiate the following:
 - 1) The longitudinal bellcrank will pivot forward (down).
 - 2) The two longitudinal links will move forward.
 - 3) The rear longitudinal bellcrank will pivot on the collective bellcrank, moving the torque link upward.
 - 4) The upward movement of the torque link will tilt the swashplate assembly forward.

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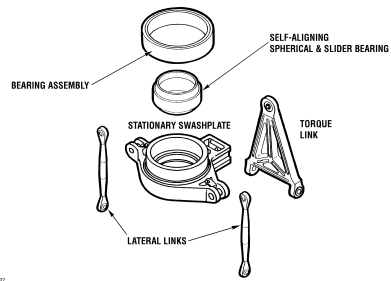


SWASHPLATE ASSEMBLY



NOTES

- e. Swashplate assembly
- (1) The purpose of the swashplate assembly is to change stationary control motion to rotational control motion. It receives and transmits control inputs from the collective and cyclic control sticks to the main rotor head assembly.
 - (2) The swashplate assembly is mounted on the static mast between the mixer assembly and the main rotor head assembly.
 - (3) The swashplate is made up of three major parts. The non-rotating swashplate (or stationary), the rotating swashplate, and the spherical slider ball.
 - (4) Major components
 - (a) Stationary swashplate
 - (b) Bearing assembly
 - (c) Self-aligning spherical and slider bearing (uniball)
 - (d) Rotating swashplate
 - 1) Upper and lower bearing retainers
 - 2) Interrupters

**STATIONARY SWASHPLATE**

63-927

NOTES

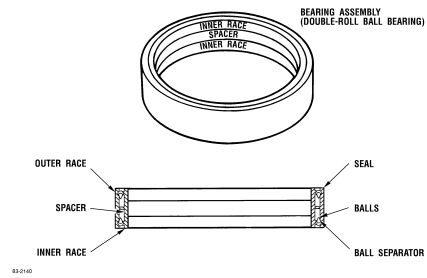
(5) Component description

- 1) Stationary swashplate
 - a) Supports the swashplate assembly and receives control inputs from two lateral links and a torque link.
 - b) Mounted to the double-row ball bearing assembly below the rotating swashplate.
 - c) The stationary swashplate is an aluminum forging with three clevis lugs for attachment of the lateral links and a torque link.
 - d) Houses the self-aligning spherical and slider bearing, and attaches to the inner race of the double-row ball bearing assembly.

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BEARING ASSEMBLY



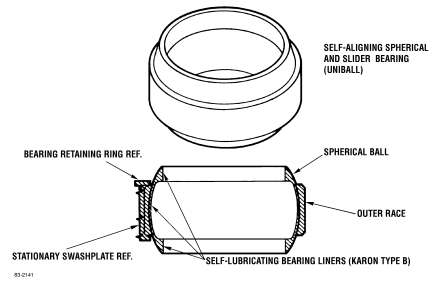
NOTES

- 2) Bearing assembly
- a) Allows the rotating swashplate to rotate.
Located between the stationary and rotating swashplate.
 - b) The bearing assembly is a double-row ball bearing assembly with a one-piece outer race and a three-piece inner race, with flexible and removable upper and lower seals.
 - c) The bearing assembly is lubricated by filling the bearing cavities 85% full with 202-223 cc of Mobilith SCH220 (HMS 2-1244 Type II) lithium grease.

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SELF-ALIGNING SPHERICAL AND SLIDER BEARING



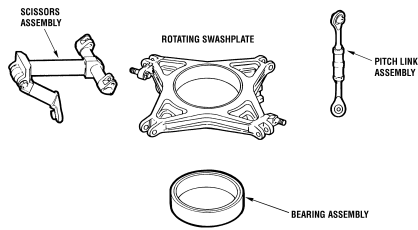
NOTES

- 3) Self-aligning spherical and slider bearing (uniball)
 - a) The spherical ball allows the swashplate assembly to tilt for cyclic control movements.
 - b) The slider bearing allows the entire swashplate assembly to move up or down the static mast as a unit, for collective control movements.
 - c) Located between the stationary and rotating swashplate.
 - d) The spherical ball and outer race material is aluminum alloy.
 - e) The spherical ball surface is chrome plated.
 - f) The outer race and slider portion of the spherical ball incorporate self-lubricating bearing liners (KARON TYPE B).
 - g) Self-aligning spherical and slider bearing (uniball) operation
 - 1) The spherical slider ball is a rounded ball that permits the swashplate to nutate (or wobble). It has a smooth polished inner diameter to slide up and down on the polished portion of the static mast. This movement transmits collective inputs to the rotor head through the pitch change links. The wobble about the ball permits cyclic input changes to the head.

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ROTATING SWASHPLATE



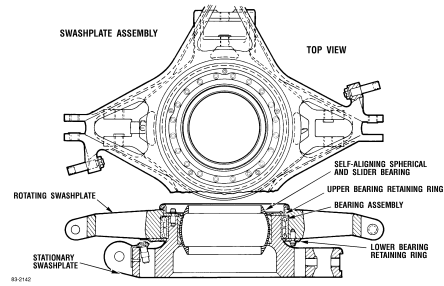
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NOTES

- 4) Rotating swashplate
 - a) Transmits control inputs received from the stationary swashplate to the main rotor head assembly via the pitch link assemblies.
 - b) Mounted to the double-row ball bearing assembly above the stationary swashplate.
 - 1) The rotating swashplate is an aluminum forging with four clevis lugs 90 degrees apart for attachment of the pitch link assemblies.
 - 2) Two of the clevis lugs (180 degrees apart) have pins for attachment of the two scissor assemblies.
 - 3) Houses the outer race of the double-row ball bearing assembly.
 - c) Operation
 - 1) The rotating swashplate rides around the stationary or non-rotating swashplate on a large duplex bearing set. The non-rotating swashplate is held stationary by the mixing unit torque link. The rotating swashplate is driven by the main rotor head through two scissors assemblies.



UPPER AND LOWER BEARING RETAINING RINGS

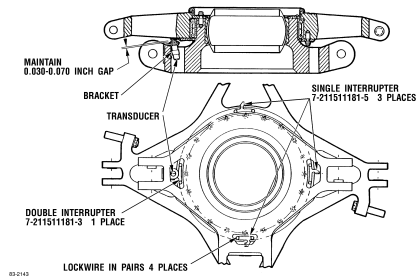


NOTES

- 5) Upper and lower bearing retainers
 - a) Secures the self-aligning spherical and slider bearing, and the double-row ball bearing assembly.
 - b) Upper bearing retainer mounts to the stationary swashplate.
 - c) Lower bearing retainer mounts to the rotating swashplate.
 - d) The upper bearing retainer secures the self-aligning spherical and slider bearing, and the inner race of the double-row ball bearing assembly, to the stationary swashplate.
 - e) The lower bearing retainer (only) secures the outer race of the double-row ball bearing assembly to the rotating swashplate.



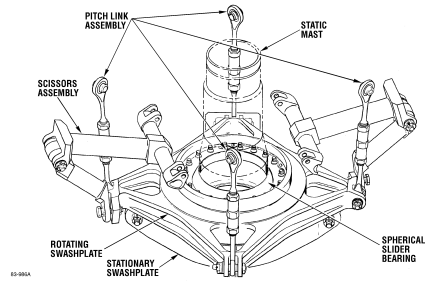
INTERRUPTERS



NOTES

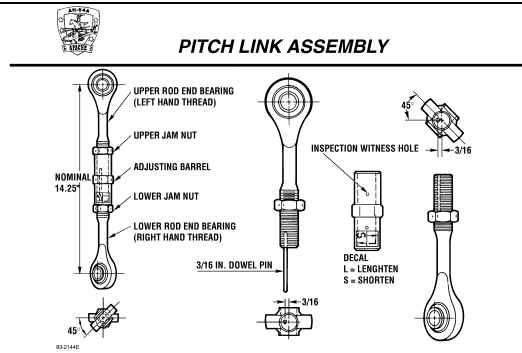
6) Interrupters

- a) Mounted to the lower side of the rotating swashplate and are used for main rotor blade tracking, which will be discussed in depth in the rotor system.

**SWASHPLATE ASSEMBLY
OPERATION****NOTES**

(6) Operation

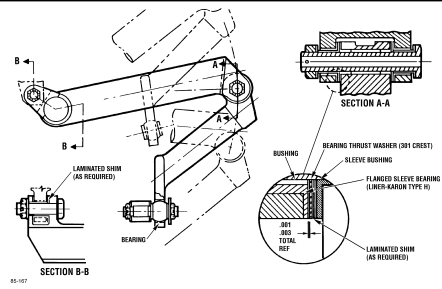
- (a) Collective input raises or lowers the swashplate assembly, changing the angle of attack of the four main rotor blades an equal amount.
- (b) Cyclic input will tilt the swashplate assembly around the spherical ball (uniball) in the desired direction.



NOTES

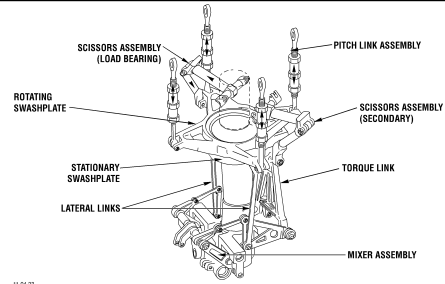
f. Pitch link assembly

- (1) The four adjustable pitch link assemblies receive control inputs from the rotating swashplate and transmit the inputs to the pitch change horns.
- (2) The pitch link assemblies are mounted between the swashplate and horns on the pitch housings.
- (3) The pitch link assemblies are adjustable to facilitate main rotor blade tracking procedures.
- (4) The left-hand threaded portion of the link must always go up.
- (5) There is an alignment pin through the barrel of the link that keeps both the left-hand and right-hand threaded rod-ends aligned.
- (6) A label on the barrel indicates the direction to turn the barrel for pitch change adjustments.
- (7) One flat on the barrel equals about one inch change at the blade tip.
- (8) The barrels and rod-ends require torquing and lock-wire.
- (9) Made with ESR steel.

**LOAD BEARING SCISSORS ASSEMBLY****NOTES**

g. Scissors assemblies

- (1) The scissors assemblies drive the rotating swashplate.
- (2) The scissors are connected to the swashplate and main rotor hub.
- (3) The scissors assemblies are made of aluminum and consist of the load bearing and secondary scissors assemblies.
- (4) The scissors assemblies consist of a lower arm and upper arm.
- (5) The scissors assemblies transmit rotational power to the rotating swashplate.
- (6) The load bearing scissors assembly drives the rotating swashplate.
- (7) The load bearing scissors assembly has spacers installed between the upper and lower arm, and between the upper arm and the main rotor head.
- (8) In case of load bearing scissors assembly failure, the secondary scissors assembly will drive the rotating swashplate.

**UPPER FLIGHT CONTROLS
OPERATION**

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NOTES

h. Torque link

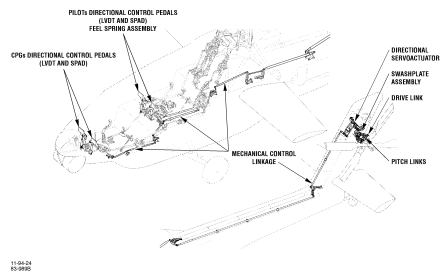
- (1) Provides vertical and longitudinal control of the stationary swashplate by the inputs received from the collective and cyclic control sticks.
- (2) Also prevents the stationary swashplate from rotating.
- (3) The torque link is mounted between the mixer assembly and the swashplate assembly.
- (4) The torque link, along with the two lateral links, will move the stationary swashplate up or down for vertical flight of the helicopter.
- (5) The torque link will also tilt the stationary swashplate forward or aft for longitudinal flight of the helicopter.

i. Lateral link

- (1) Provides vertical and lateral control of the stationary swashplate by the inputs received from the collective and cyclic control sticks.
- (2) The two lateral links are mounted between the mixer assembly and the swashplate assembly.
- (3) The lateral links, along with the torque link, will move the stationary swashplate up or down for vertical flight of the helicopter.
- (4) The lateral links will tilt the stationary swashplate right or left for lateral flight of the helicopter.
- (5) The lateral links are manufactured from ESR steel.



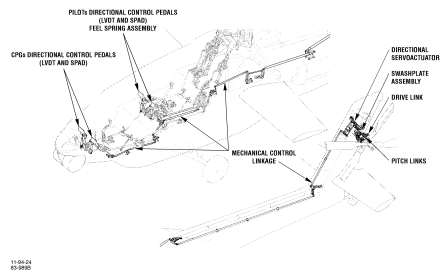
DIRECTIONAL FLIGHT CONTROL SYSTEM



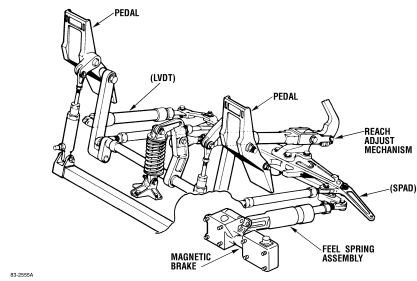
NOTES

A. Directional control system

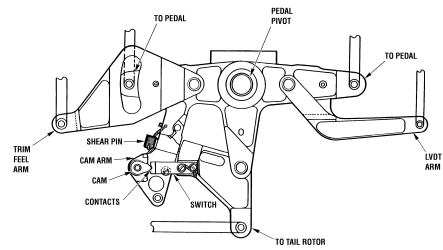
1. The directional controls on the Apache provide a means to off-set main rotor torque and control the aircraft in the yaw axis. Input to this system is through the pilot and CPG directional pedals. These are transmitted through bellcranks and push-pull tubes to the directional servoactuator located in the top portion of the vertical stabilizer.
2. The directional flight control system provides mechanical input to the tail rotor assembly for directional heading and anti-torque control.
3. The directional mechanical control linkage is routed through the lower part of the fuselage, left of the centerline, to the aft equipment bay, then along the top of the aft fuselage and tail boom to the servoactuator mounted on the tail rotor gearbox.
4. Description
 - a. It provides control for the tail rotor assembly to counter act the torque of the main rotor head assembly.
 - b. Control of the directional flight control system can be maintained from either crew station.
 - c. The system is power assisted by a hydraulic servoactuator.
 - d. Adjustable (fore and aft) pedal assemblies are installed in the pilot's and CPG's stations.
 - e. The directional mechanical control linkage incorporates a Shear Pin Actuated Decoupler (SPAD) assembly at each of the directional control pedal assemblies.
 - f. Directional control can be maintained by the Back Up Control System (BUCS). Mechanical control linkages are separately routed from the Back Up Control System (BUCS) wire harnesses for ballistic survivability.
5. Major components
 - a. Directional control pedals
 - b. Linear Variable Differential Transducers (LVDTs)
 - c. Feel spring assembly and magnetic brake
 - d. Shear Pin Actuated Decouplers (SPADs)
 - e. Mechanical control linkage

**DIRECTIONAL FLIGHT CONTROL
SYSTEM****NOTES**

- f. Directional servoactuator
 - g. Tail rotor swashplate assembly
 - h. Drive links (2)
 - i. Pitch change links (4)
- 6. Major component purpose, location, description

***DIRECTIONAL CONTROL PEDALS*****NOTES**

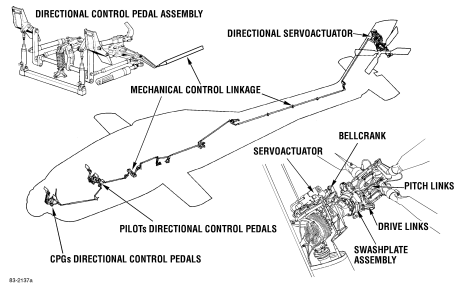
- a. Directional control pedals
 - (1) The directional control pedals provide directional (yaw) control of the helicopter by the forward and aft movement of the pedal.
 - (2) Located at the floor centerline in each crewstation.
 - (3) Made from aluminum alloy and consists of
 - (a) Brake pedal control linkage
 - (b) Reach adjust mechanism
 - (4) The brake pedal for the respective wheel brakes is applied by pivoting the upper portion of the pedals forward to apply pressure to a hydraulic master cylinder.
 - (5) The pedal reach adjust mechanism adjusts the reach of the control pedals to accommodate the reach of the crewmember.
 - (6) Movement of the directional control pedals is transmitted through mechanical linkage, directional servoactuator, tail rotor swashplate assembly, and pitch links to the tail rotor.
 - (7) This movement causes the stationary swashplate to slide inboard or outboard on the static mast to change pitch in all four blades at the same time.
 - (8) Linear Variable Differential Transducers (LVDTs)
 - (a) Identical to those described in the collective and cyclic control systems.
 - (b) The directional LVDTs are attached to the fuselage and to a riveted arm on the SPAD assembly.
 - (9) Feel spring assembly and magnetic brake
 - (a) Identical to those described in the cyclic control system.
 - (b) Installed on the pilots directional controls only.
 - (c) The directional feel spring assembly and magnetic brake are attached to the fuselage and a riveted arm assembly of the pilot's SPAD.

**DIRECTIONAL SPAD ASSEMBLY**

85-4154

NOTES

- (10) Shear Pin Actuated Decoupler (SPAD)
- (a) Identical to those described in the collective and cyclic control systems, except the directional SPADs require a force of 54 - 103 pounds (24.5 - 46.8 kilograms) for the pilot and 65 - 120 pounds (29.5 - 54.5 kilograms) for the CPG to sever the mechanical controls.
 - (b) The directional SPADs are attached to a bracket that is mounted on the fuselage bulkhead aft and below the foot pedal assemblies.

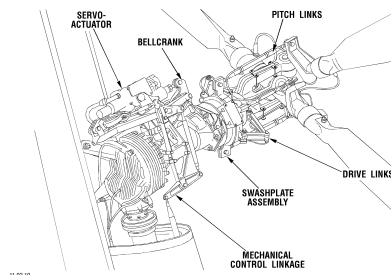
**DIRECTIONAL MECHANICAL
CONTROL LINKAGE****NOTES**

- b. Directional mechanical control linkage
 - (1) Transmits control movements from the directional control pedals to the tail rotor assembly for anti-torque (yaw) and directionally controlled flight of the helicopter.
 - (2) Mechanical linkage is routed through the lower part of the fuselage, left of the centerline, to the aft equipment bay, then along the top of the aft fuselage and tail boom section, then up the leading edge side of the vertical stabilizer to the directional servoactuator.
 - (3) Identical to those described in the collective and cyclic control systems.
- c. Directional servoactuator
 - (1) Utilizes hydraulic power to move the swashplate assembly which simultaneously moves the tail rotor blade pitch angles.
 - (2) The directional servoactuator is horizontally mounted on top of the tail rotor gearbox on the vertical stabilizer.
 - (a) Description
 - 1) Serves the same functions as the other servoactuator in the flight control system except that its physical size is 6 inches (15.2 centimeters) wide, 18.3 inches (46.5 centimeters) long at the mid-stroke position, and it weighs 36 pounds (16.3 kilograms).
 - 2) The output piston of the directional servoactuator connects directly to the directional bellcrank assembly input clevis.

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TAIL ROTOR CONTROLS



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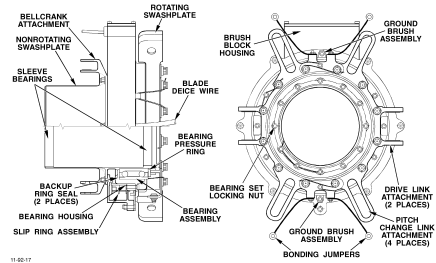
NOTES

d. Tail rotor controls

- (1) The tail rotor controls transmit control movements from the directional servoactuator to the tail rotor.
- (2) Mounted on the static support between the tail rotor gearbox and the tail rotor.
- (3) The tail rotor controls consist of a bellcrank, a swashplate, pitch change links, and drive links.
- (4) Major components
 - (a) Bellcrank assembly
 - (b) Tail rotor swashplate assembly
 - (c) Pitch change links (4)
 - (d) Drive links (2)
- (5) Component description
 - (a) Bellcrank assembly
 - 1) Transmits control movement from the directional servoactuator to the tail rotor swashplate.
 - 2) Mounted onto the directional servoactuator support and connected to the directional servoactuator and the tail rotor swashplate.
 - 3) The aluminum alloy bellcrank transmits movement of the servoactuator, and also serves to prevent rotation of the non-rotating swashplate.



TAIL ROTOR SWASHPLATE ASSEMBLY

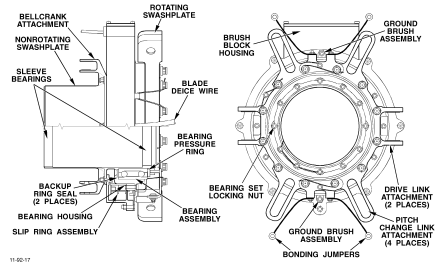


NOTES

- e. Tail rotor swashplate assembly
 - (1) Receives linear inputs from the bellcrank assembly, and transmits rotating control inputs to the tail rotor blades via the pitch change links.
 - (2) Mounted on the tail rotor gearbox static support.
 - (3) The tail rotor swashplate can be one of two versions, the older aluminum alloy version or the newer improved version of aluminum alloy and stainless steel. Tail rotor swashplate components
 - (a) Non-rotating swashplate
 - (b) Rotating swashplate
 - (c) Annular double-row ball bearing assembly
 - (d) Two (2) sleeve bearings
- f. Stationary swashplate
 - (1) The stationary swashplate receives linear control inputs from the directional servoactuator via the bellcrank assembly.
 - (2) The attachment of the bellcrank assembly also prevents the non-rotating swashplate from the rotating.
- g. Rotating swashplate
 - (1) The rotating swashplate is attached to the
 - (a) Non-rotating swashplate by the annular double-row ball bearing assembly, and transmits inputs to four (4) tail rotor pitch change links.
 - (b) The rotating swashplate is driven by two (2) drive links, which are connected to the rotating swashplate and the tail rotor.



TAIL ROTOR SWASHPLATE ASSEMBLY



NOTES

ORIGINAL SWASHPLATES

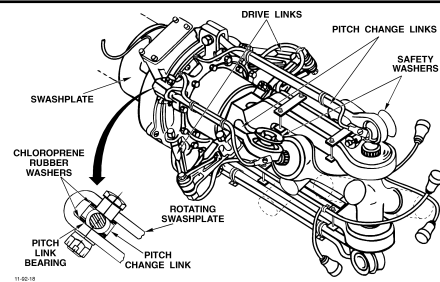
<u>DASH NO.</u>	<u>ECP 932</u>
-9	No
-11	Partial (minus bonding jumpers)
-13	Full

All aircraft with the -11 swashplate will have bonding jumpers installed to complete the incorporation of ECP 932 when the -15 swashplate is installed.

IMPROVED SWASHPLATES

<u>DASH NO.</u>	<u>ECP 932</u>	
-901	No	Replaces -9
-15	Full	Replaces -11 and -13

The -901 is the improved swashplate with the old deice wire harness and slip ring.

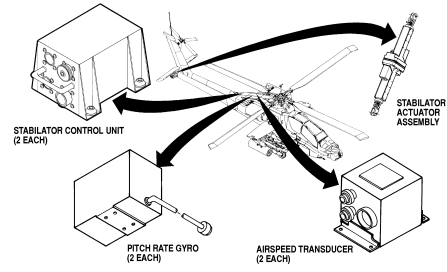
**TAIL ROTOR PITCH CHANGE LINKS
AND DRIVE LINKS****NOTES**

h. Pitch change links

- (1) Transmits control movements from the swashplate assembly to the tail rotor blades.
- (2) Mounted between the rotating swashplate assembly (180 degrees apart) and the pitch horns of the tail rotor blades.
- (3) Pitch change links are made of Electro-Slag-Remelt (ESR) steel, incorporate two self-aligning bearings, and are nonadjustable.
- (4) The pitch link to pitch horn attaching hardware includes a safety washer to prevent the catastrophic loss of the pitch link should its bearing fail.
- (5) Where the pitch link attaches to the rotating swashplate, two (2) chloroprene rubber washers have been added, one on each side of the pitch link bearing, to prevent the pitch link from gouging the swashplate.

i. Drive links

- (1) Drives the rotating swashplate.
- (2) Attached between the rotating swashplate and the tail rotor head assembly.
- (3) The drive links are made of aluminum alloy and have sleeve bearings.
- (4) The drive links receive inputs from the tail rotor head assembly to drive the rotating swashplate.

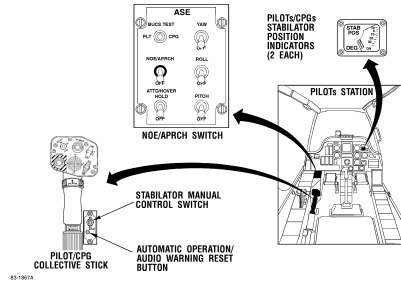
**STABILATOR COMPONENTS (1)**

11-02-00

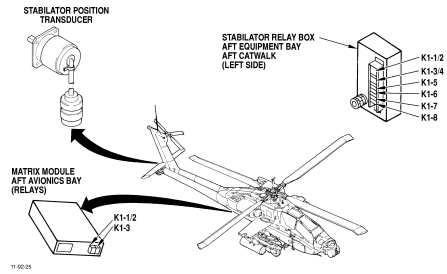
NOTES

A. Stabilator control system

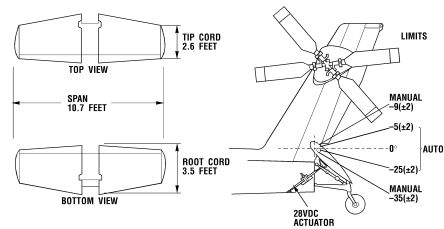
1. The stabilator control system (SCS) provides a means to automatically or manually move the stabilator to enhance helicopter handling characteristics with improved handling in the longitudinal (pitch) axis. The SCS also provides improved visibility over the nose for landing or nap-of-earth (NOE) operations.
2. There are two modes of stabilator operation, automatic and manual. The Stabilator Control System normally operates in the automatic mode. The automatic mode becomes functional when electrical power is applied to the helicopter.
 - a. In the automatic mode, the stabilator is positioned automatically based upon collective position, pitch rate, and airspeed.
 - b. The manual mode of operation is the backup for the automatic mode and will be available at any airspeed in case of automatic mode malfunction.
 - c. Either crewmember can initiate the manual mode of operation when airspeed is below 80 KTAS.
 - d. Above 80 KTAS, the automatic mode prevents manual mode initiation.
3. This system does not use any hydraulic assistance. It operates on 115 VAC and 28 VDC.
4. The symmetrical airfoil is located at the base of the vertical stabilizer.
5. The SCS is continuously monitored by the Fault Detection/Location System (FD/LS).
6. The SCS is fail-safe in that no failure of a stabilator control unit can cause an aircraft pitch rate in excess of 10 degrees per second.
7. Major components
 - a. Stabilator
 - b. No. 1 and No. 2 pitch rate gyro.
 - c. Air Data System
 - d. No. 1 and No. 2 airspeed transducers
 - e. Stabilator actuator assembly
 - f. No. 1 and No. 2 Stabilator Control Units (SCU)

**STABILATOR COMPONENTS (2)****NOTES**

- g. Stabilator manual control switch
- h. Automatic operation/audio warning reset button
- i. NOE/APRCH (Nap of the Earth/Approach) switch
- j. No. 1 and No. 2 stabilator position indicators

**STABILATOR COMPONENTS (3)****NOTES**

- k. Stabilator position transducer
- l. Stabilator relay box
- m. Matrix module

**STABILATOR**

11-64-23

NOTES

8. Component purpose, location, description, and operation

a. Stabilator

- (1) Improves longitudinal handling characteristics and forward visibility of the helicopter for improved flightcrew effectiveness.
- (2) Attached to pivot points at the base of the trailing edge of the vertical stabilizer.
- (3) Is a wing-shaped air foil with a 10.7 feet (3.26 meters) span, 2.6 feet (.79 meters) wide at the tip cord, and 3.5 feet (1.06 meters) wide at the root cord.
- (4) Operation
 - (a) Automatically controlled by two independent electrical control systems.
 - (b) Automatic mode (SCU control)
 - 1) The stabilator control units will position the stabilator automatically at or above 30 knots forward airspeed.
 - 2) In the automatic mode, the stabilator will change position according to airspeed and pitch attitude.
 - (c) Manual mode (PLT and CPG'S manual control switch)
 - 1) In manual mode, a switch on the PLT and CPG'S collective control stick will control the stabilator through the electric motor actuators when the automatic control function has failed.
 - 2) Manual control is powered by the No. 1 DC bus.
 - (d) Stabilator travel limits
 - 1) Manual mode

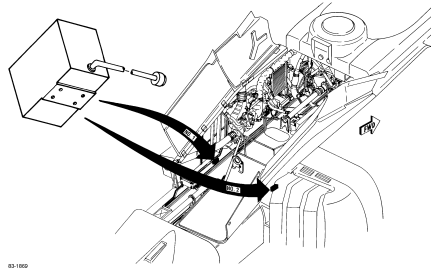
-9 (" 2) degrees to 35 (" 2) degrees.
 - 2) Automatic mode

-5 (" 2) degrees to 25 (" 2) degrees.

07-636-12



PITCH RATE GYROS



03-1000

NOTES

b. Pitch rate gyros

- (1) The pitch rate gyros provide pitch rate signals to the stabilator control units (SCU's).
- (2) Location
 - (a) The No. 1 pitch rate gyro is mounted in the left side of the aft equipment bay.
 - (b) The No. 2 pitch rate gyro is mounted in the right side of the aft equipment bay.
- (3) The pitch rate gyros are sealed, line replaceable units.
- (4) Operation
 - (a) The rate gyros are mounted in the pitch axis of the helicopter. Anytime the helicopter deviates from its present flight attitude, a signal will be developed proportional to the rate and direction of the deviation and will be supplied to the respective SCU.
 - (b) The No. 1 pitch rate gyro is excited by 26 VAC from the No. 1 SCU. It provides a pitch rate signal to the No. 1 SCU. The output of the gyro is 0.125 VDC/deg/second.
 - (c) The No. 2 pitch rate gyro is excited by 26 VAC from the No. 2 SCU. It provides a pitch rate signal to the No. 2 SCU. The output of the gyro is 0.125 VDC/deg/second.
 - (d) Each pitch rate gyro has a limited stabilator control authority of " 2.5 degrees, for a combined authority of " 5.0 degrees.
 - (e) Should either pitch rate gyro malfunction the automatic mode will disengage and the system will revert to the manual mode.

AIR DATA SYSTEM LOCATIONS

OMNIDIRECTIONAL AIRSPEED SENSOR (OAS)

AIR DATA PROCESSOR (ADP)

21-51200-1

A-162

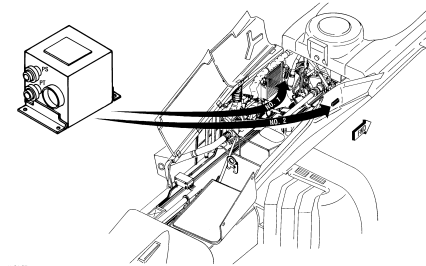
c. Air Data System (ADS)

- (1) Measures and provides airspeed, static air pressure, air temperature and side-slip information for use by the helicopter fire control equipment, DASE, display systems, and navigation systems.
- (2) Location
 - (a) The Omnidirectional Airspeed Sensor (OAS) is mounted on a non-rotating standpipe above the main rotor blade head.
 - (b) The Air Data Processor (ADP) is located in the aft avionics bay.
- (3) Description
 - (a) The OAS consists of a pair of opposed venturi-like sensors with a differential pressure transducer. The sensors are mounted on a common arm that is driven by an AC motor.
 - (b) The ADP receives inputs from the OAS, computes the OAS inputs into airspeed signals, and supplies airspeed information to various helicopter systems including the SCS.
- (4) Operation
 - (a) Changes in airspeed below 30 knots will have no effect on the SCS. When airspeed reaches 30 knots, an output of 40 mVDC/kt is supplied to both stabilator control units. The stabilator control units compare the ADS signal to the respective airspeed transducer signal. The higher of the two signals is used as one factor to compute the stabilator schedule.
 - (b) Above 58 knots, the ADS signal is not used to compute the stabilator position.
 - (c) Failure of the ADS will have no effect on SCS operation.

07-636-12



AIRSPPEED TRANSDUCER



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93-1070

NOTES

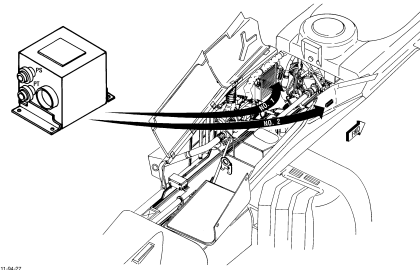
d. Airspeed transducers

- (1) Develops an electrical signal that is proportional to airspeed. The No. 1 airspeed transducer provides an airspeed signal to the No. 1 SCU and the No. 2 airspeed transducer provides an airspeed signal to the No. 2 SCU.
- (2) Location
 - (a) The No. 1 airspeed transducer is mounted in the left side of the aft equipment bay.
 - (b) The No. 2 airspeed transducer is mounted in the right side of the aft equipment bay.
- (3) Description - the airspeed transducers are sealed, line replaceable units with electrical and pitot-static connections on the front.
 - (a) One static port connection (PS)
 - (b) One pressure port connection (PT)
 - (c) One electrical connector for power and output signal interface.
- (4) Operation
 - (a) The airspeed transducers receive positive and negative 15 VDC from the respective SCU. The transducers receive impact air from the pitot tubes, develop a signal that is proportional to forward airspeed, and provides the signal to the respective SCU.
 - (b) From 0 to 30 knots, the output is a constant 2.5 VDC.
 - (c) From 30 to 180 knots, the output increases 75 mVDC per knot. The SCU starts to use the airspeed transducer signal above 58 knots.
 - (d) Above 180 knots, the output is a constant 13.5 VDC; however, airspeeds above 165 knots will have no effect on the stabilator control system.
 - (e) The No. 1 airspeed transducer provides an airspeed signal to the No. 1 SCU.
 - (f) The No. 2 airspeed transducer provides an airspeed signal to the No. 2 SCU.

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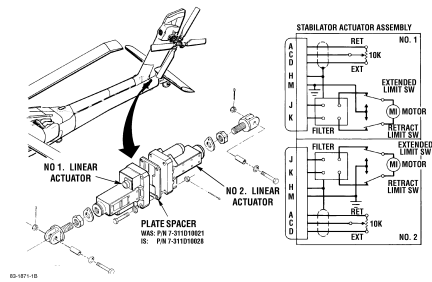
AIRSPEED TRANSDUCER



11-64-27
83-1070

NOTES

- (g) The airspeed transducer signal is used exclusively above 58 knots to compute stabilator position. Between 30 and 58 knots, each SCU compares the airspeed transducer signal to the ADS signal. The higher of the two signals is used to compute stabilator position. Below 30 knots, changes in airspeed have no effect on stabilator position.
- (h) If either of the two airspeed transducers malfunction, the automatic mode will disengage and the system will revert to the manual mode.

**STABILATOR ACTUATOR
ASSEMBLY****NOTES**

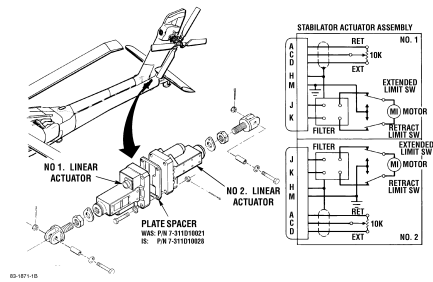
e. Stabilator actuator assembly

- (1) The stabilator actuator assembly positions the stabilator in response to commands from the Stabilator Control Units (SCUs) in the automatic mode or to the crew member commands in the manual mode.
- (2) Mounted to a fitting on the bottom of the stabilator and to the bulkhead attachment on the tail boom.
- (3) Description
 - (a) The stabilator actuator assembly consists of two tandem linear actuators mounted back-to-back, separated by a spacer which contains molded-in seals.
 - (b) The No. 1 linear actuator comprises the upper half of the actuator assembly when mounted.
 - (c) The No. 2 linear actuator comprises the lower half of the assembly.
 - (d) Each of the two linear actuator contains
 - 1) A reversible DC motor
 - 2) A potentiometer for feedback to the SCU's
 - 3) Internal retract and extend limit switches
 - (e) The actuator assembly retracted length is 23 inches and the extended length is 30 inches.

CAUTION

Loss of GEN 1 and GEN 2 will cause the stabilator to remain in its last commanded position. The stabilator will not be repositioned by either the manual mode or automatic mode.

- (4) Operation - the stabilator actuators are two electro-mechanical units that are driven by two independent DC powered electrical motors. The stabilator actuators are tandem mounted to the bottom of the stabilator and attached to the aft fuselage and tail boom section. The actuators operate in either the automatic or manual mode to position the stabilator.
- (5) Automatic operation
 - (a) The actuator assembly position is programmed by both stabilator control units (SCU).

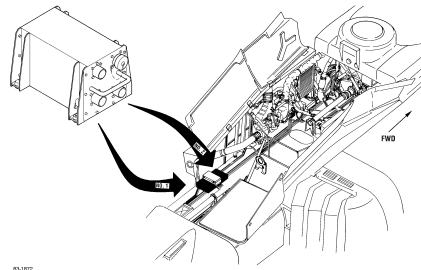
**STABILATOR ACTUATOR
ASSEMBLY****NOTES**

- (b) The No. 1 linear actuator is controlled by the No. 1 SCU, and provides 50 percent of the stabilator actuator assembly total movement.
 - (c) The No. 2 linear actuator is controlled by the No. 2 SCU, and provides 50 percent of the stabilator actuator assembly total movement.
 - (d) As the actuators extend or retract, the potentiometer inside each actuator will send a signal to the respective SCU that is proportional to actuator position. The potentiometer is excited by positive and negative 15 VDC from the respective SCU.
 - (e) The SCUs will monitor the motor position and rate.
 - (f) If the two motor positions disagree by more than 10 degrees (6.68 " 0.40 VDC), the SCUs will disengage the automatic mode of operation.
 - (g) Stabilator travel limits in the automatic mode are from 25 degrees trailing edge down to -5 degrees trailing edge up. In automatic operation actuator travel is limited by the controllers.
- (6) Manual operation
- (a) Manual operation can be initiated by either crewmember only if the airspeed is below 80 knots when the stabilator control system is operating normally.
 - (b) Manual operation is initiated by either crewmember placing the manual control switch to the NU (nose up) or ND (nose down) position when airspeed is below 80 knots.
 - (c) With the switch held in either position, both linear actuators will drive until stopped by actuation of the extend or retract limit switch. Stabilator travel limits in the manual mode are from 35 degrees trailing edge down to -9 degrees trailing edge up.
 - (d) If either half of the actuator malfunctions, the stabilator will travel only half the normal manual mode slew rate.

07-636-12



STABILATOR CONTROL UNITS



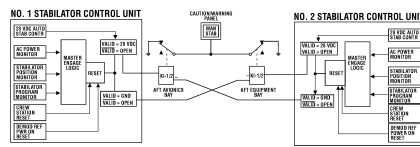
83-1072

NOTES

- f. Stabilator Control Unit (SCU)
 - (1) The SCU controls the position of the stabilator in the automatic mode of operation, in response to the following inputs
 - (a) Airspeed
 - (b) Pitch rate
 - (c) Stabilator control switches
 - (d) Collective ACTUATOR position
 - (e) Stabilator actuator position
 - (2) The No. 1 and No. 2 SCUs are located in the left side of the aft equipment bay.
 - (3) The SCU is a line replaceable, solid state unit with four electrical connectors and a handle on the front. Both SCUs are identical.



SCU ENGAGE LOGIC



88-238

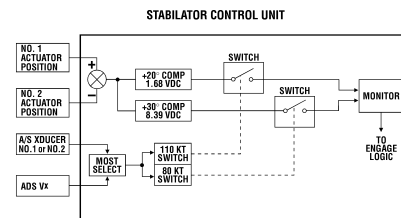
NOTES

(4) Engage logic operation

CAUTION

The automatic mode becomes operational as soon as electrical power is applied to the helicopter. If the stabilator is not in the 25 degree trailing edge down position when power is applied, it will be programmed to that position immediately. Exercise caution and ensure nothing is under the stabilator before applying electrical power.

- (a) When electrical power is applied to the helicopter, each SCU does a built-in-test. If the engage logic of both stabilator control units is correct, the automatic mode will become operational immediately.
- (b) Engagement of the SCU is automatic when electrical power is applied to the helicopter if
 - 1) The AC power monitor is satisfied.
 - 2) The Stabilator POSITION monitor is satisfied.
 - a) It compares the position of the two actuators which make up the stabilator actuator assembly. If the position of two actuators is greater than 10 degrees, the automatic mode will not engage.
 - b) The monitor checks the position of the stabilator at 80 and 110 knots.
 - c) If the feedback signal from the actuator is greater than the equivalent of 30 degrees at 80 knots, the SCU will command the automatic mode to disengage within 1.25 seconds.
 - d) If the feedback signal from the actuator is greater than the equivalent of 20 degrees at 110 knots, the SCU will command the automatic mode disengage within 150 milliseconds.
 - 3) The 26 VAC demodulator reference is present. Upon application of electrical power, the 26 VAC demodulator voltage commands the master engage logic to reset.

**STABILATOR PROGRAM MONITOR**

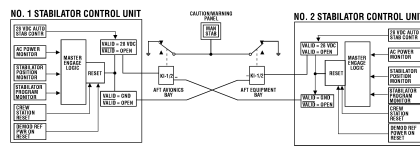
00-225

NOTES

- 4) Stabilator PROGRAM monitor
- a) The SCU stabilator monitor checks the feedback position of the two motor actuators at 80 and 110 knots.
 - b) If the feedback position at 80 knots is more than 30 degrees (8.39 ± 0.4 VDC), the engage logic will be commanded to a fail condition within 1.25 seconds.
 - c) If the feedback position at 110 knots is more than 20 degrees (1.68 ± 0.4 VDC), the engage logic will be commanded to a fail condition within 150 milliseconds.



SCU ENGAGE LOGIC



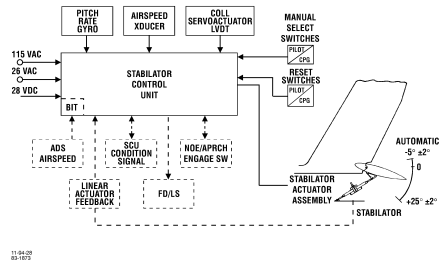
88-238

NOTES

- 5) SCU engage logic
 - a) If the monitors are satisfied and the proper voltages are present, the master engage logic causes 28 VDC to be applied to the coil of one of the K1-1/2 relays and a ground to be applied to the coil of the opposite K1-1/2.
 - b) With power from one SCU and a ground from the other SCU, both of the relays energize.

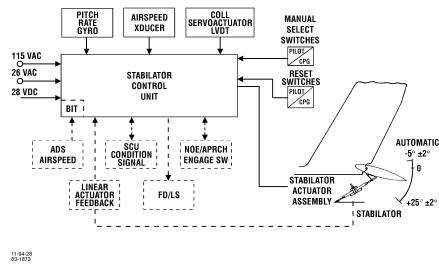


STABILATOR CONTROL UNIT SCHEMATIC

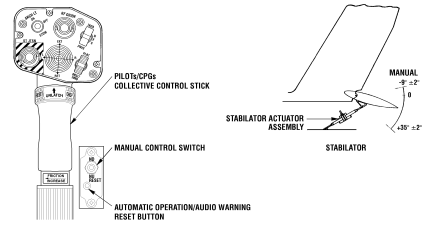


NOTES

- (5) SCU operation
 - (a) The No. 1 SCU controls the No. 1 linear actuator and the No. 2 SCU controls the No. 2 linear actuator. Together, the SCUs control 100 percent of the stabilator actuator assembly travel.
 - (b) SCU inputs
 - 1) 115 VAC
 - 2) 26 VAC demodulation reference voltage
 - 3) 28 VDC
 - 4) Pilot and CPG manual select switches.
 - 5) Pilot and CPG RESET switch
 - 6) NOE/APPR engage switch
 - 7) Collective position information from the collective SERVOACTUATOR linear variable differential transducers (LVDT). When collective is increased, the stabilator is positioned downward. The collective LVDT input is limited to 7.5 degrees of stabilator movement per stabilator control unit.
 - 8) Pitch rate information from the respective pitch rate gyro. Each pitch rate gyro has a maximum authority of ± 2.5 degrees of stabilator movement.
 - 9) Air data system
 - 10) Airspeed information from the respective airspeed transducer and the Air Data System (ADS). Each airspeed transducer has a minimum authority of ± 8.5 degrees of stabilator movement.
 - 11) Actuator position No. 1
 - 12) Actuator position No. 2
 - (c) From these inputs, the SCU computes the position the stabilator should be in, then compares the computed signal with actual stabilator position. Actual stabilator position is provided by a feedback signal from the potentiometer in each linear actuator of the stabilator actuator assembly.
 - (d) The SCUs then signal the stabilator actuator assembly to move the stabilator to the correct position.
 - (e) As the actuator assembly extends or retracts, the 10 K ohm potentiometer in each actuator provides a feed back signal proportional to actuator position to the respective SCU.

**STABILATOR CONTROL
UNIT SCHEMATIC**11-50-05
03-1075**NOTES**

- (f) The SCUs compare the position of the actuator. If the actuator positions differ by more than 10 percent the automatic mode of operation will become inoperable, the warning tone will be heard and the MAN STAB light will illuminate.
- (g) Each SCU constantly monitors itself for proper operation through a built-in test (BIT) system and monitors the condition of the other SCU through the SCU condition circuit. If any component of the Stabilator Control System malfunctions, the automatic mode will disengage and system operation will revert to the manual mode.
- (h) The SCUs are monitored by the fault detection/location system (FD/LS).

**STABILATOR CONTROLS**

83-1074

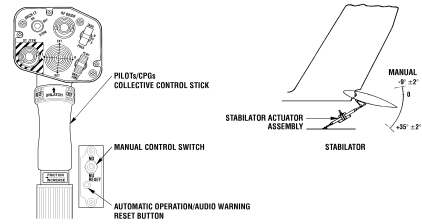
NOTES

g. Stabilator manual control switch

- (1) The manual control switch allows the crew to disengage the automatic mode and manually position the stabilator.
- (2) The manual control switch is mounted on the pilot's and CPG's collective control sticks.
- (3) The manual control switch is a 3-position (NU-OFF-ND) toggle switch, spring loaded to the OFF position.
- (4) During normal operation, the manual control switch is enabled only when the airspeed is below 80 knots. If the automatic mode becomes inoperative (malfunction), the manual control switch is enabled regardless of airspeed.
 - (a) If the airspeed is below 80 knots, placing the manual control switch to the NU (Nose Up) or ND (Nose Down) position will disengage the automatic mode of operation and move the stabilator to the desired attitude manually.
 - 1) ND position will move the stabilator trailing edge down.
 - 2) NU position will move the stabilator trailing edge up.
 - 3) Center position - manual mode disengaged.
 - (b) During normal operation (automatic mode), if airspeed is above 80 knots, the manual control has no effect on the stabilator.
 - (c) When the manual control switch is used to position the stabilator, the stabilator can be driven to a maximum of 35 degrees trailing edge down (positive) or 9 degrees trailing edge up (negative).

h. Automatic operation/audio warning reset button

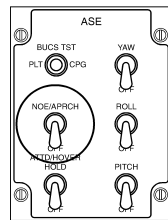
- (1) The purpose of the automatic operation/audio warning reset button is to regain the stabilator automatic mode of operation, if the automatic mode has disengaged itself due to a transient fault, or if the manual mode has been initiated by either crewmember. The automatic operation/audio warning reset button will also reset (disable) the stabilator warning audible tone.
- (2) The reset buttons are on the stabilator manual control panels which are attached to the inboard side of each collective control stick.
- (3) The automatic operation/audio warning reset button is a push on, release off, momentary contact switch.

**STABILATOR CONTROLS**

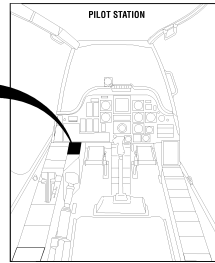
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NOTES

- (4) If the Stabilator Control System automatic mode malfunctions, the manual mode is engaged and a warning tone will be enabled. Pressing either reset button will:
- (a) Reset (disable) the warning tone.
 - (b) Reset (engage) the automatic mode if the malfunction was temporary.
 - (c) Release the NOE/APRCH switch to the OFF position. If the manual mode is initiated by either crew member, either reset button may be used to restore the automatic mode.
 - (d) Reengage the automatic mode after the manual mode has been initiated by either crewmember.

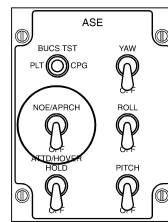
**NOE/APPROACH SWITCH**

80-73

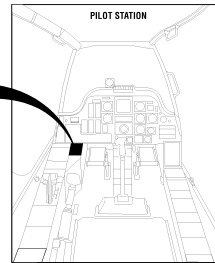
**NOTES**

i. NOE/APRCH switch

- (1) The NOE/APRCH switch may be placed in the NOE/APRCH position at any speed. The switch retains the automatic mode and positions the stabilator 25 degrees trailing edge down when airspeed decreases below 80 knots. This will provide better visibility for the crewmembers when NOE flight is undertaken or when better forward visibility is desired. Above 80 knots, the automatic mode will continue to operate normally.
- (2) The NOE/APRCH switch is located on the pilot's ASE control panel.
- (3) The NOE/APRCH switch is a two-position toggle switch NOE/APRCH and OFF. The switch is magnetically latched in the NOE/APRCH position and spring loaded to OFF.
- (4) Operation
 - (a) When the switch is in the OFF position, it allows normal automatic mode operation of the Stabilator Control System.
 - (b) When the automatic mode is operating the switch can be placed in the NOE/APRCH position at any airspeed. When the switch is manually placed in the NOE/APRCH position, it is magnetically latched in that position.
 - (c) When airspeed is below 80 knots and the switch is in the NOE/APRCH position, the stabilator is positioned 25 degrees trailing edge down by the SCU's until 80 knots forward airspeed is achieved.
 - (d) At 80 knots forward airspeed, the Stabilator Control System will revert to normal operation and the stabilator will be positioned as determined by the SCUs.
 - (e) When the switch is placed in the NOE/APRCH position above 80 knots, it will have no effect on the SCS until airspeed reduces to 80 knots; then the stabilator will move to 25 degrees trailing edge down.
 - (f) The switch will not latch in the engage position during manual mode operation.
 - (g) The switch may be returned to the OFF position in any one (1) of four (4) ways.
 - 1) Pilot physically moves switch to OFF.
 - 2) Operating the Manual Control Switch when airspeed is below 80 knots.

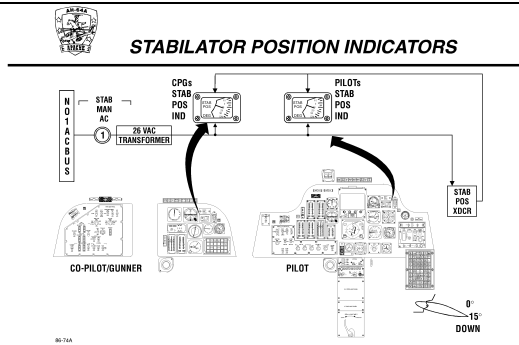
**NOE/APPROACH SWITCH**

DC-73

**NOTES**

- 3) Pressing the Automatic Operation/Audio Warning Reset Button.
- 4) Faulty SCU's - if the automatic mode malfunctions, the NOE APRCH switch will return to OFF.

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NOTES

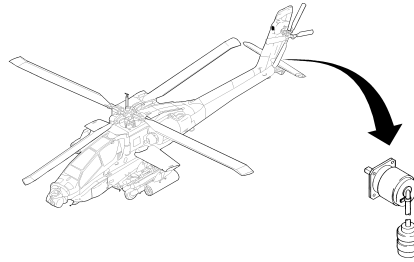
j. Stabilator position indicators

- (1) The stabilator position indicators provide the crew with a visual indication of stabilator position.
- (2) A stabilator position indicator, along with a placard, is located in each crewmember's station, in the upper right-hand portion of the respective instrument panel.
- (3) The stabilator position indicators are labeled with the legend STAB POS DEG and have a rectangular indicator face.
 - (a) The indicator is scaled from 10 degrees trailing edge up to 35 degrees down trailing edge down in 5 degree increments.
 - (b) A dial pointer to indicate the trailing edge position on the scale.
 - (c) An OFF flag
- (4) Operation
 - (a) Operating voltage is applied to the stabilator position indicators and the stabilator position transducer from the No. 1 AC bus via the 26 VAC step-down transformer located in the electrical power distribution center.
 - (b) As the stabilator moves, the transducer develops a proportional signal and applies it to the stabilator indicators.
 - (c) The pointer will move to indicate the position of the stabilator trailing edge as commanded by the stabilator position transducer.
 - (d) The OFF flag will be visible when power is lost or removed from the indicator.
 - (e) The OFF flag will retract out of view when power is applied to the indicator.

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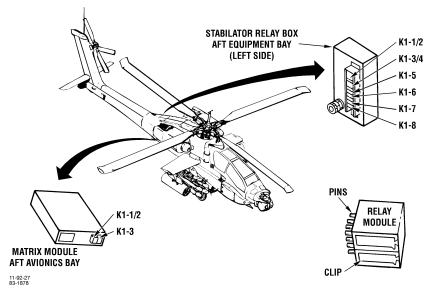
STABILATOR POSITION TRANSDUCER



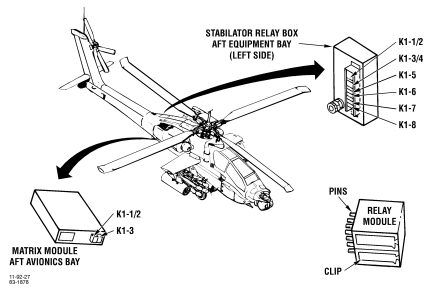
CS-1077

NOTES

- k. Stabilator position transducer
 - (1) The stabilator position transducer monitors stabilator position and provides a signal to the stabilator position indicators.
 - (2) The position transducer is centrally mounted between the stabilator and the fuselage at the pivot point of the stabilator.
 - (3) The position transducer is a cylindrical synchro transmitter.
 - (4) Operation
 - (a) Excitation power for the transducer is 26 VAC from a step-down transformer located in the electrical power distribution panel.
 - (b) As the stabilator moves, the transducer develops a corresponding signal to drive the pilot's and CPG's stabilator position indicators.

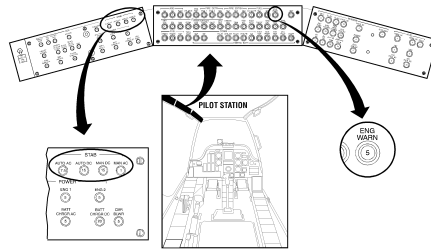
**STABILATOR RELAY BOX AND
MATRIX MODULE****NOTES**

1. Stabilator relay box and matrix module
 - (1) The stabilator relay box and matrix module provide mountings for the Stabilator Control System relays.
 - (2) Location
 - (a) The stabilator relay box is mounted on the left side of the aft equipment bay.
 - (b) The matrix module is located in the aft avionics bay.
 - (3) Description
 - (a) The stabilator relay box contains six SCS relays
 - 1) AUTO/MAN (auto/manual) Relay (K1 - 1/2)
 - 2) Manual Select Relay (K1 - 3/4)
 - 3) Manual Control Relay (K1 - 5)
 - 4) Auto Reset Relay (K1 - 6)
 - 5) Approach Relay No. 1 (K1 - 7)
 - 6) Approach Relay No. 2 (K1 - 8)
 - (4) The matrix module contains two SCS relays
 - (a) AUTO/MAN Relay (K1 - 1/2)
 - (b) Manual Control Relay (K1 - 3)
 - (5) Relay operation
 - (a) AUTO/MAN relays (2 each) (K1 - 1/2) - energized for automatic mode operation.
 - (b) The AUTO/MAN relay located in the aft avionics bay is supplied 28 VDC by the No. 1 SCU and a ground by the No. 2 SCU.
 - (c) The AUTO/MAN relay in the aft equipment bay is supplied 28 VDC by the No. 2 SCU and a ground by the No. 1 SCU.
 - (d) Manual Control relays (K1 - 5 and K1 - 3) energized for manual mode operation.

**STABILATOR RELAY BOX AND
MATRIX MODULE**

NOTES

- (e) Manual Select relay (K1 - 3/4) energized for manual mode below 80 knots. Inhibits the automatic mode during manual operation.
- (f) Auto Reset relay (K1 - 6) energized to reset automatic mode and/or stabilator audio warning.
- (g) Approach relays No. 1 and No. 2 (K1 - 7 and K1 - 8) energized for 1 second when airspeed increases through 80 knots. When energized, K1 - 7 disables the MAN STAB caution lights; K1 - 8 disables the stabilator audio warning. K1 - 7 and K1 - 8 prevent false failure indications when the automatic mode is engaged during the 80 knot transition and the stabilator angle at engagement is out of tolerance.

**CIRCUIT BREAKERS**

00-75

NOTES

m. Circuit protection

- (1) Circuit breakers provide electrical power and circuit protection for the stabilator control system.
- (2) The SCS circuit breakers are located on the pilot's center and aft overhead circuit breaker panels. Four circuit breakers labeled STAB AUTO AC and DC, and STAB MAN DC and AC.
- (3) Description
 - (a) STAB AUTO AC circuit breaker
 - 1) Provides single-phase 115 VAC from the No. 1 AC bus automatic mode operation.
 - 2) Rated at 7.5 amps.
 - (b) STAB AUTO DC circuit breaker
 - 1) Provides 28 VDC from the No. 3 DC bus for the automatic mode of operation.
 - 2) Rated at 15 amps.
 - (c) STAB MAN DC circuit breaker
 - 1) Provides 28 VDC from the No. 1 DC bus for the manual mode of operation.
 - 2) Rated at 15 amps.
 - (d) STAB MAN AC circuit breaker
 - 1) Provides 115 VDC from the No. 1 AC bus for the step-down transformer. The transformer supplied 26 VAC to the stabilator position transducer and indicator.
 - 2) Rated at 1 amp.
 - (e) ENG WARN circuit breaker
 - 1) Provides 28 volts from the emergency DC bus to give audio warning reset capabilities if an electrical system failure should occur.
 - 2) Rated at 5 amps.

- n. MAN STAB caution lights
 - (1) Gives an indication to the crew that the SCS is operating in the manual mode.
 - (2) The MAN STAB warning lights are on both C/W/A panels.
 - (3) The MAN STAB warning lights are amber colored.
 - (4) Operation
 - (a) If the SCS automatic mode malfunctions at any airspeed, the warning lights will illuminate, and a warning tone will be heard in the headsets. The warning tone can be reset, but the light will remain illuminated as long as the automatic mode is malfunctioning.
 - (b) If airspeed is below 80 knots and the pilot or CPG uses the manual control switch to reposition the stabilator, the MAN STAB caution lights will illuminate and remain illuminated until automatic operation is restored by:
 - 1) Increasing airspeed above 80 knots.
 - 2) Pressing either of the Automatic Operation/Audio Warning Reset buttons.
 - (c) When the light illuminates due to the crew initiating the manual mode, the warning tone will not be activated.

The schematic diagram illustrates the electrical connections for the STROBE CONTROL UNIT. It features two main control units, NO. 1 and NO. 2, which interface with various aircraft systems and the STROBE ACTUATOR ASSEMBLY. Inputs to the control units include AIRSPED SENSING, NOSE APPROACH, and PITCH RATE. The control units manage the STROBE LIGHTS and the EXTEND/RETRACT LIGHTS. The STROBE ACTUATOR ASSEMBLY includes the STROBE ACTUATOR and the STROBE LIGHTS. The diagram also shows the connection to the STROBE ACTUATOR ASSEMBLY, which includes the STROBE ACTUATOR and the STROBE LIGHTS.

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B. Stabilator Control System Automatic Mode Operation

1. SCU inputs

- a. 28 VDC from the STAB AUTO DC circuit breaker.
- b. 115 VAC from the STAB AUTO AC circuit breaker.
- c. Airspeed information from Air Data System is used for airspeeds from 30 to 80 knots.
- d. Airspeed information from the respective airspeed transducer is used for airspeeds above 80 knots.
- e. Collective control stick position information from the collective servoactuator transducer (LVDT).
- f. NOE/APRCH function select switch position.
- g. Pitch rate input from the respective pitch rate gyro.
- h. The validity of the opposite SCU (reason check).

2. Input utilization

- a. The stabilator control system will schedule the position of the stabilator from positive 25 degrees trailing edge down to negative 5 degrees trailing edge up as a function of the airspeed, collective actuator position, and pitch rate inputs.

(1) Airspeed inputs

- (a) Airspeed information is not used to schedule the position of the stabilator below 30 knots.
- (b) Above 30 knots, the signals from the ADS and the respective airspeed transducer are sent through a "most select" circuit inside the SCU. The greater of the two airspeeds is used to schedule the stabilator position.
- (c) Above 80 knots, the respective airspeed transducer supplies airspeed to it's SCU.
- (d) The airspeed effect on stabilator position is limited to negative 8.5 degrees by each SCU, for a total of negative 17 degrees of stabilator motion.
- (e) The result of the airspeed input is summed with the collective LVDT input inside each SCU.

(2) Collective LVDT inputs

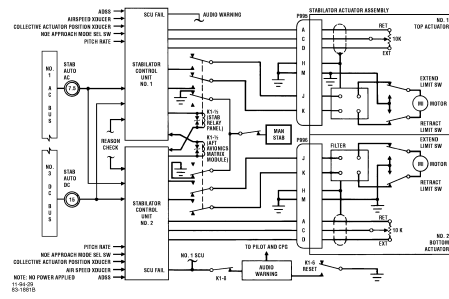
The schematic diagram illustrates the control system for the 1000 Series. It features two main control units, NO. 1 and NO. 2, which interface with a 1000 Series Actuator Assembly and a 1000 Series Motor. The control units receive inputs such as AIR-SPEED SENSING, AIR-APPROACH SENSING, and PITCH RATE. They output signals to the actuator assembly, which in turn controls the motor's extension and retraction. The diagram also shows the connection to a 1000 Series Motor and a 1000 Series Actuator Assembly.

A-206

- (a) The collective LVDT input is a function of airspeed and has a linear gain from 30 to 50 knots. When the airspeed is greater than 50 knots, the gain is constant.
 - (b) The collective LVDT input is limited to positive 7.5 degrees of stabilator motion by each SCU, for a total of positive 15 degrees of stabilator motion.
 - (c) The result of the collective LVDT input is summed with the pitch rate gyro input.
- (3) Pitch rate gyro input
 - (a) The pitch rate gyro input is linear and is limited to positive and negative 2.5 degrees by each SCU, for a total of positive and negative 5.0 degrees of stabilator motion.
 - (b) The output of each SCU to the respective actuator is derived from summing the input signals.
 - 1) Airspeed
 - 2) Collective LVDT inputs
 - 3) Pitch rate gyro signal
 - (c) The stabilator will be controlled simultaneously by both SCUs.
 - (d) Each SCU will provide a drive signal equal to half of the required stabilator travel.
- b. Stabilator actuator position is fed back to the respective SCU by the 10 K ohm potentiometer in each actuator. The feedback signal is used to prevent overshoot when the stabilator is being driven, and is constantly compared by both SCUs. If the actuator motor positions disagree by more than 10 degrees, the SCUs will generate a failed condition.
- c. In addition to scheduling stabilator position, the SCUs monitor the stabilator system components and performance. A failure of the components disengages the automatic mode and reverts the system to manual control operation.
 - (1) Either stabilator control unit
 - (2) Either airspeed transducer
 - (3) Either pitch rate gyro
 - (4) Either half of the stabilator actuator assembly.



AUTOMATIC MODE SCHEMATIC

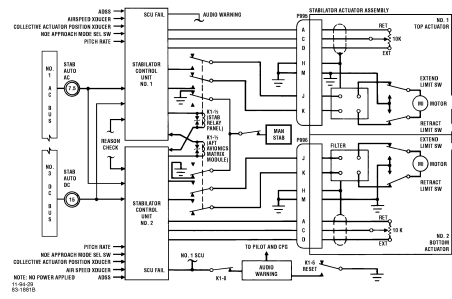


NOTES

- d. Each stabilator control unit monitors demodulated reference voltage from the DASE system 26 VAC, 400 hertz step-down transformer (the No. 1 SCU monitors T2 and the No. 2 SCU monitors T1). A voltage drop to 21 VAC, plus or minus 2 VAC, will cause automatic mode disengagement.
3. System power up
- a. When AC and DC electrical power is applied to the helicopter, each SCU performs a built-in test to determine its validity. When the built-in test is satisfied, the automatic mode will become operational.
 - (1) Each SCU outputs 28 VDC to the respective (K1-1/2) AUTO/MAN relay. Each SCU also provides a ground to the opposite AUTO/MAN relay.
 - (a) K1-1/2 for SCU No. 1 and the top actuator is mounted in the STAB relay panel.
 - (b) K1-1/2 for SCU No. 2 and the bottom actuator is mounted in the AFT avionics module matrix .
 - (2) The AUTO/MAN relays route SCU control voltage to the respective actuator motor to drive the stabilator to the scheduled position.
4. Automatic Mode
- a. The automatic mode is operational any time that:
 - (1) Electrical power is applied to the aircraft.
 - (2) STAB AUTO AC and STAB AUTO DC circuit breakers are closed.
 - (3) The SCS self test has passed.
 - b. Once these conditions have been met the AUTO MAN RELAYS energize.
 - c. The SCS will conduct a self-test, and if the SCU's circuit logic are correct, automatic mode programming of the stabilator will commence immediately.
 - d. When the SCUs determine that circuit logic is correct, the AUTO MAN relays (K1-1/2) will energize.
 - e. The AUTO MAN RELAYS then apply motor drive voltages from the SCU to the respective actuator motor to drive the stabilator to the position computed by the SCU.
 - f. The actuator motor position is sent back to the respective SCU by the 10 K OHM potentiometer for comparison with the other actuator position. If the actuator motor positions disagree by more than 10 degrees, the SCU logic will generate a fail condition, and cause the automatic mode to disengage. A disengage command will also be caused by a malfunction of:

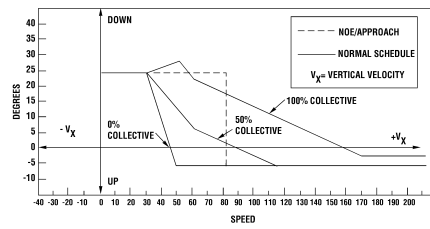


AUTOMATIC MODE SCHEMATIC



NOTES

- (1) AC or DC power
 - (2) Either airspeed transducer
 - (3) Either pitch rate gyro
 - (4) Either collective actuator XDUCER
 - (5) Either SCU
 - (6) Either AUTO MAN relay
- g. Automatic mode malfunction operation
- (1) Both AUTO/MAN relays deenergize
 - (a) Each relay is controlled by both SCU's, as a part of the safety interlock.
 - (b) As a result, a failure in one SCU will cause both AUTO/MAN relays to deenergize.
 - (2) The MAN STAB caution light on both C/W/A panels will illuminate and the stabilator audio warning tone will be heard.
 - (3) Pressing the pilot's or CPG's automatic operation/audio warning reset button will disable the warning tone and attempt to reengage the automatic mode.
 - (4) If the fault is not cleared, the SCS will stay in the manual mode and the MAN STAB caution lights will remain illuminated.
 - (5) If the fault has cleared, the automatic mode will be re-engaged and the MAN STAB caution lights will extinguish.
- h. In the automatic mode, the stabilator actuator assembly will be positioned by the SCU, depending on the pitch rate signal, airspeed signal, and collective control stick position signal.

**NOE/APPROACH FUNCTION**

07-1882

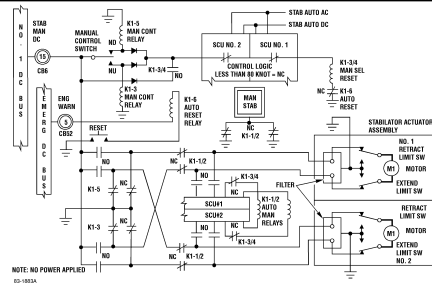
NOTES

5. NOE/APPR (Nap of the Earth/Approach) Function

- a. The NOE/APRCH switch may be placed in the NOE/APRCH position at any airspeed.
 - (1) If NOE/APRCH is selected above 80 knots, the automatic mode will continue to operate normally.
 - (2) If NOE/APRCH is selected and airspeed goes below 80 knots, the stabilator will be driven to 25 degrees trailing edge down.
 - (3) The stabilator will remain 25 degrees trailing edge down as long as airspeed remains below 80 knots.
 - (4) When airspeed is increased to 80 knots, the stabilator control system will revert to normal scheduling by the automatic mode, and the stabilator actuator assembly will program to a position that corresponds to collective control stick position, pitch rate, and airspeed.



MANUAL STABILATOR OPERATION



NOTES

6. Stabilator Control System Manual Mode Operation

- a. The manual mode is provided to give either crew member the capability of controlling the stabilator position when the automatic mode fails or when airspeed is less than 80 knots.
- b. When power is applied to the aircraft, the automatic mode begins to operate. The AUTO MAN Relays (K1-1/2) are energized through the normally closed contacts of K1-3/4. The contacts of K1-1/2 reverse. This connects the output of each SCU to the respective actuator motor for automatic mode of operation, and opens the circuit to the MAN STAB caution lights on both C/W/A panels.
- c. When airspeed is above 80 knots, control logic within the SCUs will open the circuit to the coil of the Manual Select Relay (K1-3/4). Actuation of the manual control switch above 80 knots will have no effect on the SCS.
- d. When airspeed decreases below 80 knots, control logic inside the SCUs cause the contacts to close, completing the circuit from the manual control switch to the coil of the MAN SEL (Manual Select) Relay.
- e. Power is available to the manual control switch from the No. 1 DC bus via the STAB MAN DC circuit breaker.
- f. If either crewmember places the manual control switch in the NU (Nose Up) position, the MAN CONT (Manual Control) Relay (K1-3) will energize and the contacts of K1-3 (bottom left corner of schematic) will reverse.
- g. At the same time, voltage is applied through the NU diode and the control logic (closed below 80 knots), to the coil of the MAN SEL Relay K1-3/4. Ground is applied through the normally closed (NC) contacts of the AUTO RESET relay (K1-6), to K1-3/4 energizing it and changing states of the contacts.
 - (1) The NO contacts close, applying a holding circuit to the coil of K1-3/4.
 - (2) The NC contacts open causing the AUTO MAN Relays (K1-1/2) to deenergize.
- h. When the AUTO MAN Relays deenergize
 - (1) The NO contacts open, interrupting the circuits from the SCUs to the actuator motors.
 - (2) The NC contacts close:
 - (a) One set of NC contacts cause the MAN STAB caution lights on both C/W/A panels to illuminate.
 - (b) The other set of NC contacts complete the manual mode circuit.
- i. Power to the actuator assembly motors, with the manual control switch held in the NU position, originates from the No. 1 DC bus via CB6.

[illegible]

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- j. From CB6, 28 VDC is routed through the energized closed NO contacts of K1-3, the NC contacts of K1-1/2, to the extend side of the motor.
- k. Ground return for the actuator assembly motors is provided through the NC contacts of K1-5.
- l. The motors will drive until the manual control switch is released, or the extend limit switches open.
- m. When the manual control switch is released to the center OFF position, the MAN STAB caution light will remain illuminated because of the holding circuit that keeps K1-3/4 energized, which keeps the AUTO MAN Relays deenergized.
- n. With airspeed below 80 knots, either crewmember can place the manual control switch in the nose down (ND) position. This will cause MAN CONT Relay K1-5 to energize.
- o. Power to the actuator assembly motors, with the manual control switch held in the ND position, originates from the No. 1 DC bus via CB6.
 - (1) From CB6, 28 VDC is routed through the energized closed NO contacts of K1-5, the NC contacts of K1-1/2, to the retract side of the motor.
 - (2) Ground return for the actuator motors is provided by the NC contacts of K1-3.
- p. The motors will drive until the Manual Control Switch is released to OFF, or the retract limit switches open.
- q. When the manual control switch is released to the center OFF position, the MAN STAB caution light will remain illuminated because of the holding circuit that keeps K1-3/4 energized, which keeps the AUTO MAN Relays deenergized.
- r. The automatic mode can be restored by either of two ways; increasing airspeed above 80 knots, or either crewmember manually pressing the automatic operation/audio warning reset button.
- s. Pressing the reset button will energize K1-6 from the emergency DC bus via the ENG WARN circuit breaker which will open the NC contacts, causing K1-3/4 to deenergize.
 - (1) When K1-3/4 deenergizes, the NO contacts open which removes the holding circuit from K1-3/4.
 - (2) The NC contacts of K1-3/4 close and allow the SCUs to energize the AUTO MAN Relays.
- t. The NO contacts of the AUTO MAN relay energize closed and the NC contacts energize open.
 - (1) The open NC contacts extinguish the MAN STAB lights on the C/W/A panels.
 - (2) The closed NO contacts connect the control output of the SCUs to the respective actuator motor.

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- u. The automatic mode is operational and the SCUs control the stabilator.
- v. Airspeed increase above 80 knots will
 - (1) Cause the control logic in the SCUs to open the circuit to the coil of K1-3/4.
 - (2) Operation from this point is identical to the reset button operation.



SCU INTERFACE
CONNECTOR J1/P985

PIN	SIGNAL	CHARACTERISTICS
G	MOTOR CONTROL POWER HIGH	28 VDC
C	MOTOR CONTROL POWER LOW	GND
L	MOTOR CONTROL HIGH	28 VDC
M	MOTOR CONTROL LOW	GND
F	MOTOR CONTROL SHIELD	GND
E	DC INTERLOCK POWER HIGH	28 VDC
K	DC INTERLOCK POWER LOW	GND
A	AC POWER HIGH	115 VAC, 400 Hz
B	AC POWER LOW	GND
D	CHASSIS GROUND	GND
J	SIGNAL GROUND	GND
H	STABILATOR FAIL LIGHT	VALID = OPEN FAIL = GND

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NOTES

D. Connector J1 interface (P985 for No. 1 SCU, P989 for No. 2 SCU)

1. Pin A - rate gyro low - return
2. Pin B - rate gyro high - 0.125 VDC/deg/sec
3. Pin C - shield for rate gyro
4. Pin D - input from airspeed transducer
5. Pin E - return to airspeed transducer
6. Pin F - shield for airspeed transducer wires
7. Pin G - collective actuator position high (2.8 vrms/inch (volts root mean square/inch)
8. Pin H - collective actuator position low
9. Pin J - shield for collective actuator signal
10. Pin K - air data system velocity ref high (40 mVDC/kt used by SCU program monitor)
11. Pin L - air data system velocity ref low
12. Pin T - air data system shield - ground



SCU INTERFACE
CONNECTOR J2/P986

PIN	SIGNAL	CHARACTERISTICS
A B C	RATE GYRO LOW RATE GYRO HIGH RATE GYRO SHIELD	0.125 VDC/DEG/SEC GND
D E F	AIRSPEED HIGH AIRSPEED LOW AIRSPEED SHIELD	0-30 KTS = +2.25 VDC 38-189 KTS = 75 MVDC/KT 189-200 KTS = 12.5 VDC GND
G H J	COLLECTIVE ACTUATOR POSITION HIGH COLLECTIVE ACTUATOR POSITION LOW COLLECTIVE ACTUATOR POSITION SHIELD	2.8 VRMS/INCH GND
K L T	ADS V ₁ REF HIGH ADS V ₁ REF LOW ADS V ₂ REF SHIELD	-50 TO 210 KTS = 40 MVDC/KT 0 KT = 0 VDC GND

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NOTES

C. Connector J2 interface (P986 for No. 1 SCU, P990 for No. 2 SCU)

1. Pin G - motor control power, 28 VDC in when in auto mode
2. Pin C - motor control return, ground when in auto mode
3. Pin L - motor control, 28 VDC out when extending in the auto mode, return for 28 VDC when retracting in the auto mode
4. Pin M - motor control, return when extending in the auto mode, 28 VDC out when retracting in the auto mode
5. Pin F - motor control shield
6. Pin E - DC interlock power high - 28 VDC in, used to energize the AUTO MAN RELAYS
7. Pin K - DC interlock power low - ground for 28 VDC interlock
8. Pin A - AC power high - 115 VDC, Phase B, 400 Hz
9. Pin B - AC power low - ground
10. Pin D - chassis ground
11. Pin J - signal ground
12. Pin H - stabilator fail caution light - valid = open, fail = ground



SCU INTERFACE
CONNECTOR J2/P986
CONTINUED

PIN	SIGNAL	CHARACTERISTICS
Z	DEMOD REF HIGH	26 VAC, 400 Hz, 0.5 mA MAX CURRENT
M	DEMOD REF LOW	GND
P	80 KT SW PULSE	NORMALLY OPEN ACCELERATING THROUGH 80 KT = GND FOR 1 SEC
Y	ADS V ₁ CONT HIGH	-50 to 210 KT = 40 MVDC/KT @ KT = 0 VDC
R	ADS V ₁ CONT LOW	
V	ADS V ₂ CONT SHIELD	
S	NOE/APPR LOGIC HIGH	NOE/APPR = 28 VDC NOE/APPR = 5K TO GND
ZA	ACT POS BUFF IN HIGH	4 VDC/INCH
ZC	ACT POS BUFF IN LOW	
ZB	AUTO MAN RELAY LOW	VALID = GND VALID = OPEN
W	SELF TEST INTERLOCK	ROTOR BRAKE ON = 28 VDC

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NOTES

13. Pin Z - demod ref high - 26 VAC, Phase B, 400 Hz
14. Pin M - demod ref low - ground
15. Pin P - 80 knot sw pulse - normally open - ground for 1 second when accelerating through 80 knots - No. 1 SCU energizes K1-7, No. 2 SCU energizes K1-8.
16. Pin Y - ADS Vx control high (-50 kt to 210 kt = 40 mVDC/kt used to program stabilator position)
17. Pin R - ADS Vx control low
18. Pin V - ADS shield
19. Pin S - NOE/APPR logic high (NOE = 28 VDC)
20. Pin ZA - actuator position high (4 VDC/inch)
21. Pin ZC - actuator position low
22. Pin ZB - AUTO MAN RELAY low (Valid = GND, Not Valid = Open) No. 1 SCU provides ground for AUTO MAN RELAY in aft avionics bay; No. 2 SCU provides ground for AUTO MAN RELAY on stabilator relay panel.
23. Pin W - self test interlock (rotor brake on = 28 VDC)



SCU INTERFACE
CONNECTOR J3/P987

PIN	SIGNAL	CHARACTERISTICS
U D 9	AIRSPPEED XDUCER POWER HIGH AIRSPPEED XDUCER POWER LOW AIRSPPEED XDUCER SHIELD	+15 VDC -15 VDC GND
P H N L M	RATE GYRO POWER NO. 2 RATE GYRO POWER NO. 1 RATE GYRO POWER GND RATE GYRO REF HIGH RATE GYRO REF LOW	26 VAC, 400 Hz 26 VAC, 400 Hz GND, REF 26 VAC, 400 Hz
Z ZC	ACTUATOR POSITION BUFF OUT HIGH ACTUATOR POSITION BUFF OUT LOW	4 VDC/INCH
Y	AUTO/MAN RELAY HIGH	VALID = 28 VDC NOT VALID = OPEN
F	RESET LOGIC	RESET = SWITCH CLOSURE TO GND NOT RESET = OPEN SWITCH
W	RATE GYRO TORQUER HIGH	TEST = 28 VDC NOT TEST = OPEN
A B T C	MOTOR POSITION EXCITATION LOW MOTOR POSITION INPUT MOTOR POSITION EXCITATION/HIGH MOTOR POSITION SHIELD	-15 VDC 4.0 VDC/INCH +15 VDC GND
R S	MANUAL INHIBIT HIGH MANUAL INHIBIT LOW	PIN J3-R SHORTED TO J3-S <80 KNOTS PIN J3-R-1M2 TO J3-S >80 KNOTS

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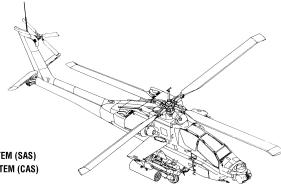
NOTES

E. Connector J3 interface (P987 for No. 1 SCU, P991 for No. 2 SCU)

1. Pin U - airspeed transducer power high (+ 15 VDC)
2. Pin D - airspeed transducer power low (-15 VDC)
3. Pin b - airspeed transducer shield
4. Pin P - rate gyro power - 26 VAC, 400 Hz (No. 1 SCU = No. 1 rate gyro)
5. Pin H - rate gyro power - 26 VAC, 400 Hz (No. 1 SCU = No. 1 rate gyro)
6. Pin N - rate gyro power ground
7. Pin L - rate gyro reference high - 26 VAC, 400 Hz
8. Pin M - rate gyro reference low
9. Pin Z - actuator position buffer out high (4 VDC/inch) (Signal from DASEC)
10. Pin ZC - actuator position buffer out low
11. Pin Y - AUTO/MAN RELAY high - valid = 28 VDC, not valid = open (No. 1 SCU provides power for AUTO MAN RELAY on the stabilator relay panel; No. 2 SCU provides power for AUTO MAN RELAY in the aft avionics bay).
12. Pin F - Reset logic - reset = switch closure to ground; not reset = open
13. Pin W - rate gyro torquer high - test = 28 VDC; not test = open
14. Pin A - motor position excitation low = -15 VDC
15. Pin B - motor position input - 4.0 VDC/inch
16. Pin T - motor position excitation high = + 15 VDC
17. Pin C - motor position shield
18. Pin R - manual inhibit high - below 80 knots, pins R&S shorted
19. Pin S - manual inhibit low - above 80 knots, more than 1 megohm between pins R&S



DASE FEATURES



- STABILITY AUGMENTATION SYSTEM (SAS)
- COMMAND AUGMENTATION SYSTEM (CAS)
- ATTITUDE HOLD
- TURN COORDINATION
- HOVER AUGMENTATION SYSTEM (HAS)
- HEADING HOLD
- BACKUP CONTROL SYSTEM (BCS)

11-60-21
63-1072

NOTES

A. AH-64A Digital Automatic Stabilization Equipment (DASE) System

1. Purpose

- a. The DASE system reduces the pilot work load by providing limited hands-off control of the aircraft.
- b. The DASE system provides a fly-by-wire Back Up Control System (BUCS) in the event the primary flight control system becomes jammed or severed.

2. Features and capabilities

- a. Stability Augmentation System (SAS)
- b. Command Augmentation System (CAS)